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ACCORDING TO DATA FROM RADIOACTIVE IODINE INDICATION AND
BASAL METABOLISM

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THE FUNCTION OF THE THYROID GLAND IN DIABETES MELLITUS
ACCORDING TO DATA FROM RADIOACTIVE IODINE INDICATION AND
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Following is the translation of an article by Z. I. Tsyukhno entitled "Funktsiya Shchitovidnoy Zhelezny pri Sakharnom Diabete po Dannym Indikatsii Radioaktivnym Yodom i Osnovnogo Obmena" (English version above) in Problemy Endokrinologii i Gormonoterapii (Problems of Endocrinology and Hormone Therapy), Vol. VI, No. 3, 1960, pages 86-90.7

From the Clinical Division (Scientific Director - Prof. M. A. Kopelovich) of the Ukrainian Institute of Experimental Endocrinology (Director - candidate of medical sciences S. V. Maksimov) and the Department of Endocrinology and Pathophysiology (Director - honored worker in science Prof. S. G. Genes) of the Ukrainian Institute for the Advanced Training of Physicians (Director - Docent I. I. Ovsyienko)

The value of the use of radioactive iodine in the diagnosis of the functional state of the thyroid gland is widely recognized at the present time (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27). The majority of authors consider that this method, with respect to the precision of its results, surpasses the method of basal metabolism determination and other methods.

By now there have been published data on the functional activity of the thyroid in thyroid pathology, diseases of the cardiovascular system, nervous system, etc. However, there are very few studies on the use of radioactive iodine for the purpose of diagnosing the function of the thyroid gland in diabetes mellitus. There is evidence in the literature that, upon intraperitoneal injection of I^{131} , there is an increased concentration of this isotope in the thyroid, liver, kidneys, and heart in rats with alloxan diabetes as compared with controls (22). Some authors indicate that the increased fixation of I^{131} in the thyroid does not testify to an increased production of thyroid hormone and may be

related to the direct extrapancreatic effect of alloxan, i.e. to alloxan toxicity. K. G. Nikulin (1956) discovered a reduced uptake of I^{131} by the thyroid gland in studies over the course of two hours in 14 patients with diabetes, although this returned to normal by 24 hours.

We ran studies on the functional state of the thyroid gland by the method of I^{131} radioactive indication in 78 patients with diabetes mellitus. In processing our material, we excluded the data on nine of the patients: of these, seven had received iodine preparations and two had received vitamin B₁. Of the remaining 69 patients, 30 were men and 39 were women, aged ten to 55 years. In 31 of the patients, the disease was severe, in 33 it was moderate, and in five mild. In four patients, there were accompanying manifestations of thyrotoxicosis. Signs of hypothyroidism or of myxedema were not observed in any of our patients.

Methods

As indicator doses, foreign authors use 40 to 100 microcuries I^{131} (25, 26, 27), but an indicator dose of 100 microcuries, under conditions of normal uptake, leads to a concentration of radioactive iodine in the thyroid gland which is only ten times less than the minimal dose causing destructive phenomena in the tissues of that gland (3). Not having at their disposal convincing data regarding the complete safety of irradiation with doses of radioactive iodine of this magnitude, Soviet authors use, for these purposes, considerably smaller doses: two to four microcuries (1, 18, 4) or one to two microcuries (7, 9, 3, 10, 6, 19). These indicator doses are absolutely harmless to the organism.

We used a minimal indicator dose of I^{131} - one microcurie, which was given orally in five ml of distilled water. Observations were carried out under basal metabolic conditions - with complete physical and mental rest, in the morning, in the fasting state after 12 hours of no food, with the patient in the horizontal position. The concentration of radioactive iodine in the thyroid was determined with the aid of a B-2 apparatus, with attention to the intensity of gamma-radiation, two and 24 hours after taking the indicator dose. The norm of I^{131} uptake by the thyroid gland after two hours shows a variation, according to the findings of various authors, within limits of three to 13 percent (5, 7, 16, 1, 20, 2), and after 24 hours, within limits of eight to 40 percent (25, 27, 18, 3, 9, 7, 15, 1, 20, 17, 14, 2). We adopted

limits of four to 12 percent as the normal for uptake in two hours, and eight to 40 percent in 24 hours (on the basis of the data from the radiology laboratory and the Ukrainian Institute of Experimental Endocrinology).

Results

Table 1 shows the data on the two-hour uptake of I^{131} in 65 patients with diabetes mellitus without accompanying signs of disturbance in the function of the thyroid gland.

Table 1

Uptake of I^{131} by the thyroid gland in patients with diabetes after two hours

Accumulation of I^{131} after two hours	Number of patients
Reduced (three percent or less)	19
Normal (four to 12 percent)	38
Increased (13 percent or more)	8

In the group of patients with reduced two-hour uptake of radioactive iodine, the indices varied from zero to 3.8 percent, and in those with increased uptake, from 12 to 23.7 percent.

We tried to study the special features of the uptake of radioactive iodine as a function of the level of glycosuria, hyperglycemia, cholesterol, blood pressure, and the presence of certain complications of diabetes.

To demonstrate the separate influence of these or other factors is difficult, but it could be noted that deviations from normal were seen primarily in patients with advanced diabetes, of four to five years' duration. The group of persons with reduced uptake comprised chiefly patients with a level of blood sugar from 300 to 600 mg percent, with moderate or marked glycosuria (20 to 50 gm, occasionally 100 gm), receiving insulin in doses of 40 to 70 units or more. In the group of persons with normal I^{131} uptake, there were primarily patients with a level of blood sugar of 200 to 300 mg percent, moderate or marked glycosuria (20 to 100 gm), receiving large doses of insulin (usually more than 70 units).

The group of patients with increased I^{131} uptake included those with a level of blood sugar usually within limits of 200 to 300 mg percent, glycosuria from 50-100 gm, and insulin doses of 40 to 70 units per day.

Among the patients under our observation, 45 had a blood pressure within normal limits, nine had low pressure, and 11 had high blood pressure (in nine of these it was transitory, and in the other two it was stable). According to the data in the literature, the thyroid function with radioactive iodine studies may vary, principally in stages II and III of hypertension (8, 11). We could not demonstrate any substantial tendencies with respect to the magnitude of the two-hour uptake of radioactive iodine in diabetes as a function of normal or reduced blood pressure, or of transitory increased blood pressure (Table 2).

We were unable to show any regularities in the two-hour uptake as a function of different complications of diabetes (polyneuritis, cataracts, amphotontosis, etc.). There was only a slight prevalence of complications of diabetes in the group of patients with reduced two-hour uptake of radioactive iodine.

Table 2

Magnitude of two-hour uptake of radioactive iodine and levels of blood pressure

Blood pressure	Number of patients	I^{131} uptake in two hours		
		normal (4-12%)	reduced (3% and less)	increased (13% and more)
Normal	45	28	11	6
Reduced	11	6	4	1
Increased	9	4	4	1

Certain authors remark (13) that in hypercholesterolemia, fixation of radioactive iodine by the thyroid is preferentially reduced. We investigated the level of cholesterol in the blood in 45 patients, of whom in 29 it was within the limits of 125 to 150 mg percent, as determined by the Engel'gard-Smirnova method, in nine it was within limits of 151 to 175 mg percent, and in seven it exceeded normal limits (180 to 200 mg percent or more). It was

noted that, in patients with hypercholesterolemia or levels of cholesterol approaching the upper limits of normal, the uptake of radioactive iodine was reduced or normal.

In studies of I^{131} uptake after 24 hours (Table 3), it was normal in 64 of 65 persons with clinically unchanged functions of the thyroid gland. In 32 patients, the indices of the 24-hour uptake of radioactive iodine were within normal limits - 16 to 25 percent, in 18 they were at the upper limits of normal - 26 to 40 percent, and in 15 they were at the lower limits of normal - 10 to 15 percent. The lowest uptake after 24 hours was 10.1 percent. Consequently, after 24 hours there was a levelling off both of the increased and of the decreased figures for the two-hour uptake, regardless of the severity of the diabetes, the presence or absence of acidosis and other complications, the duration of the disease, etc. Only in one patient was the 24-hour uptake of radioactive iodine slightly increased (41.2 percent).

Table 3

Percent of I^{131} uptake by the thyroid gland in patients with diabetes after 24 hours

Percent uptake of I^{131}	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45
Number of patients	—	5	10	16	16	7	6	4	1

Our data confirm the evidence of Ye. A. Kolli and N. A. Shtegeman that, with the two-hour determination, the differences between the indices in the various groups are more marked than with the 24-hour determination.

In patients with concomitant diabetes and thyrotoxicosis, the figures for I^{131} uptake were increased both after two hours (20.8 to 51.9 percent) and after 24 hours (48.7 to 75.8 percent).

In 40 patients, along with studies of the thyroid function using radioactive iodine, we ran studies of the basal metabolism with the Knipping apparatus. We were unable to find in the literature any figures comparing the results of studies of thyroid function with the use of radioactive iodine with results of studies of basal metabolism in patients with diabetes.

It turned out that, against a background of normal two-hour radioactive iodine uptake (Table 4), the figures for basal metabolism were either increased, decreased, or within the limits of normal. With reduced uptake of radioactive iodine, the figures for the basal metabolism were also reduced, increased, or normal. The same picture of variations in basal metabolism was also seen in instances of increased uptake of I^{131} .

Table 4

Values for two-hour uptake of I^{131} by the thyroid in diabetes mellitus against a background of different levels of basal metabolism

Basal metabolism	No. of patients	I ¹³¹ uptake in two hours		
		normal (4-12%)	reduced (3% or less)	increased (13% or more)
Normal (\pm 10%)	17	13	3	1
Reduced (-11 to -37%)	17	7	7	3
Increased (+13 to +43%)	6	3	2	1

The values for 24-hour uptake of radioactive iodine were within normal limits in 38 of 40 patients in which studies of basal metabolism were made. At the same time, the values for the basal metabolism in 17 patients were within normal limits, in 16 were reduced (from -11 to -37 percent), and in five were increased (from +13 to +43 percent).

Consequently, no parallelism could be demonstrated between the values for the two-hour and 24-hour uptakes of I^{131} and the basal metabolism in diabetes. Only in a few patients was there a rough correlation between the results. The absence of parallelism between the findings of studies of radioactive iodine uptake and basal metabolism testifies to the fact that these tests characterize different aspects of the activity of the thyroid, as well as to the fact that

the indices of basal metabolism in diabetes mellitus depend not only on the state of the thyroid gland but also on other factors as well.

Conclusions

(1) The level of two-hour uptake of radioactive iodine by the thyroid gland in diabetes mellitus is within the limits of normal in the majority of cases (38 of 65 patients); however, in a number of patients, it may be either reduced or increased in the absence of clinical signs of disrupted thyroid function.

(2) The values of the 24-hour uptake of I^{131} by the thyroid are within normal limits in diabetes mellitus.

(3) In the presence of concomitant diabetes and thyrotoxicosis, the I^{131} uptake is considerably increased at two and 24 hours, just as in other forms of thyrotoxicosis.

(4) There is ordinarily no parallelism between the indices of the thyroid uptake of I^{131} and the values of basal metabolism in diabetes mellitus.

(5) Reduction in the basal metabolism which is occasionally seen in patients with diabetes is, apparently, largely of extrathyroid etiology.

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